A PREVIEW OF

EVENT SCREENING AND SELECTION ON DATA FROM THE GLAST BALLOON PROTOTYPE

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Abstract

The triggering and data analysis for the GLAST balloon prototype, like that of the GLAST gamma-ray telescope planned for launch in 2006, is much more flexible than was the case for the CGRO/EGRET instrument. Furthermore, the much larger data volume expected from GLAST/LAT precludes the type of manual event review that was done for EGRET data. Thus a great deal of attention must be given to the software "cuts" that are used to eliminate the huge background of events produced by charged cosmic rays without reducing significantly the efficiency for gamma-ray detection.

Event screening on data from the July 2001 GLAST balloon flight has reduced the background so that a good measurement of the atmospheric gamma rays is possible, and we are starting on the much more difficult problem of pushing the background down to a level that (in the absence of atmospheric secondaries) would allow measurements of cosmic gamma-ray fluxes. We will describe the types of cuts being used, as well as their effects on both the background and the gamma-ray efficiency. The performance of the prototype as an imaging gamma-ray telescope will be demonstrated using Monte Carlo simulations in addition to the balloon data.

GLAST BALLOON PROTOTYPE

Launched on 2001/08/04

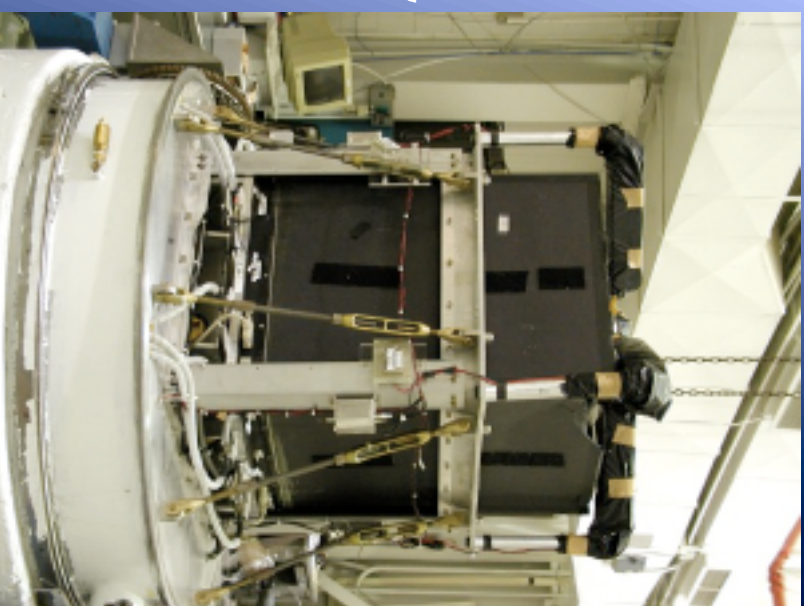One of 16 towers that constitutes the Large Area Telescope (LAT) on GLAST

Objects:
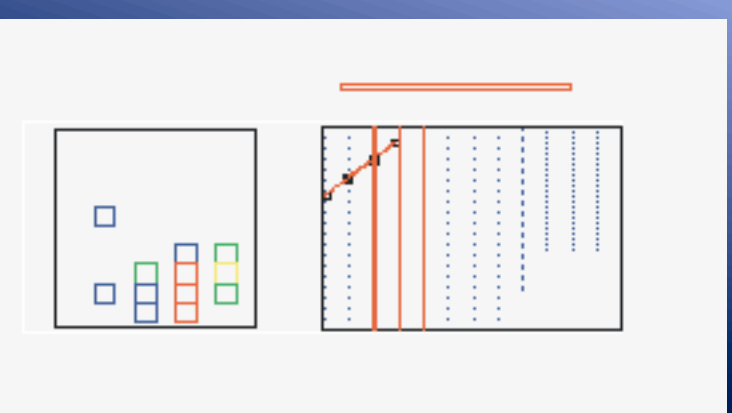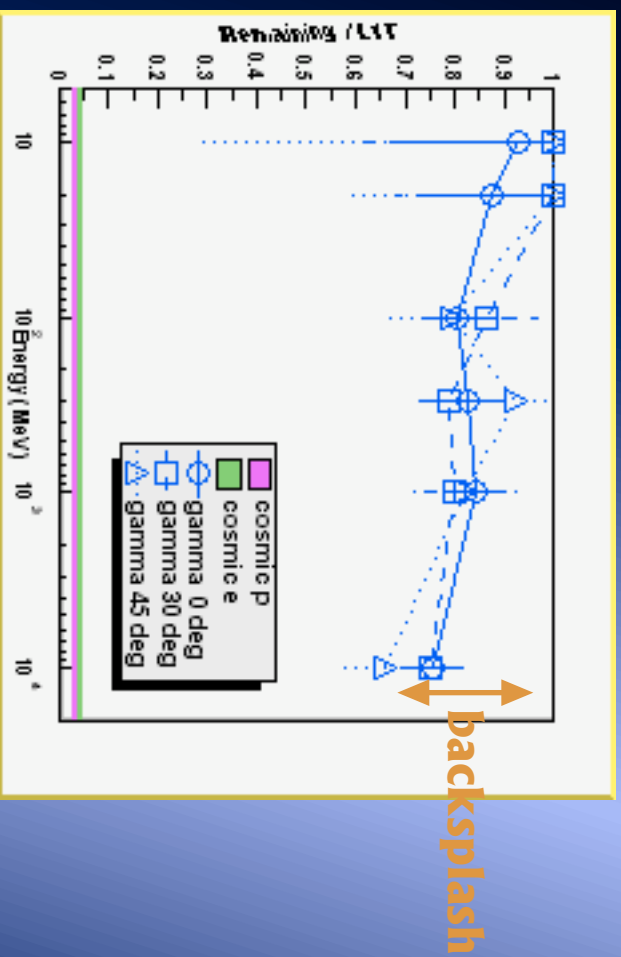Validate the LAT design
Record particle incidents
Find an efficient data analysis chain
…

FILTER: ANTI-COINCIDENCE DETECTOR (ACD)

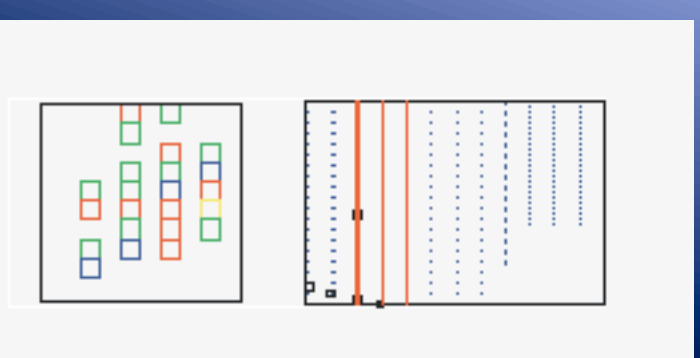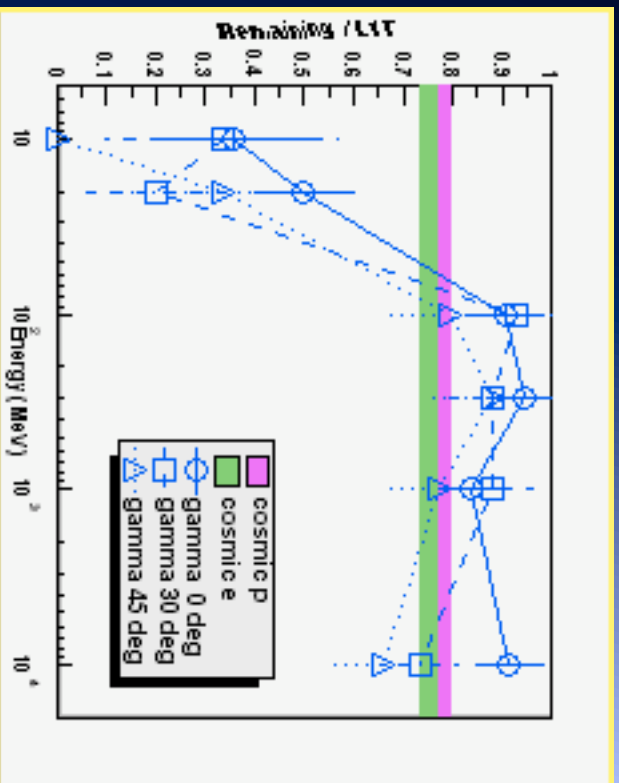If (any ACD tiles are lit && E in CAL < 50 MeV) then cut

… A simple veto.

Simulation

An example from flight data
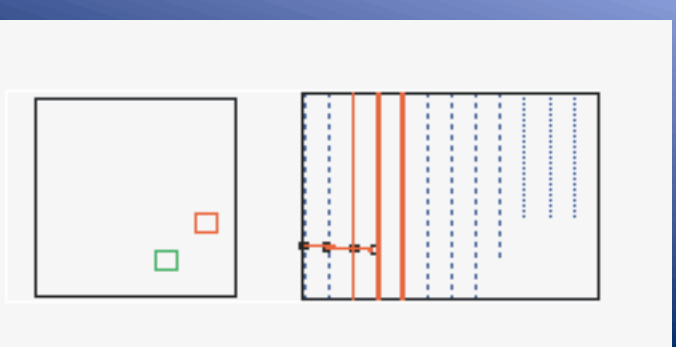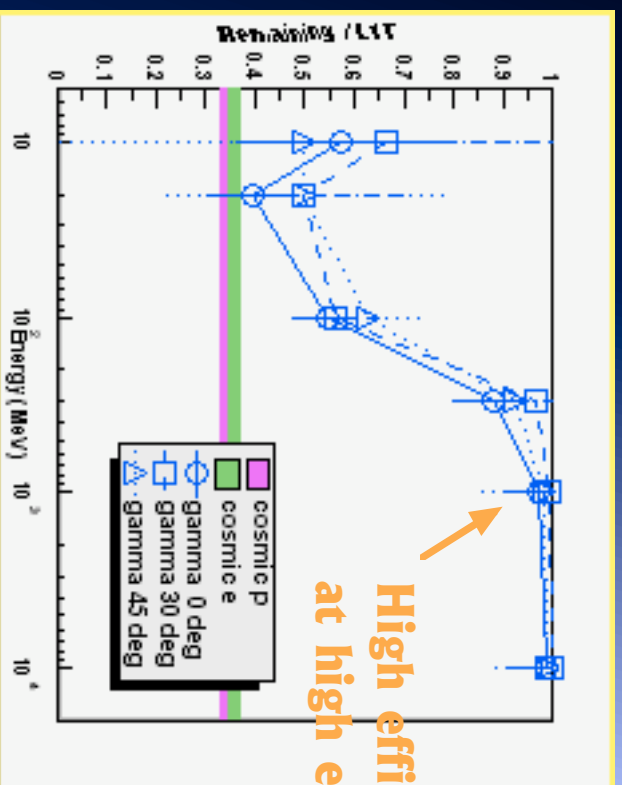
FILTER: TRACK-QUALITY

If (TKR_qual < 10.) then cut
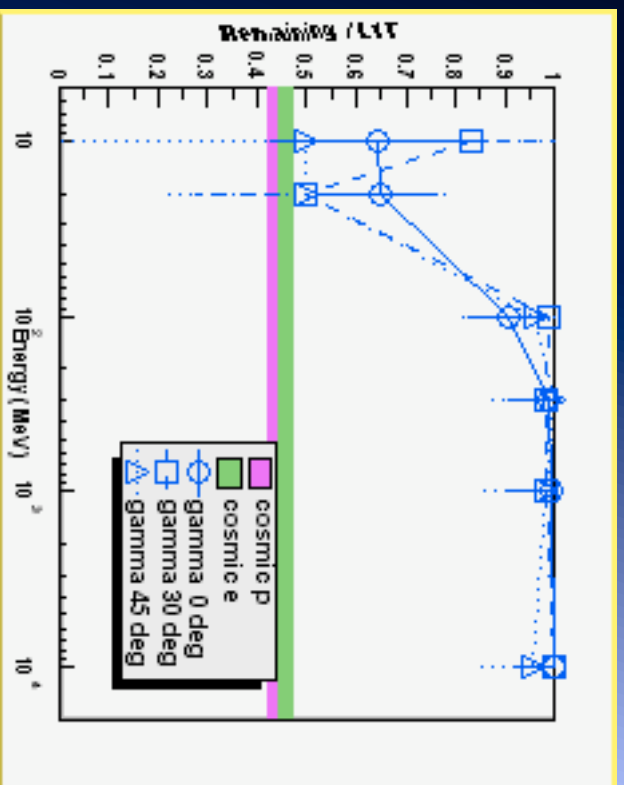TKR_qual: An empirical parameter representing the goodness of the fit (reconstruction)

A reconstruction failure

FILTER: Λ

If (num of X-Z track < 2 || num of Y-Z track < 2) then cut

… A Λ shape (e⁻e⁺ pair) must be found

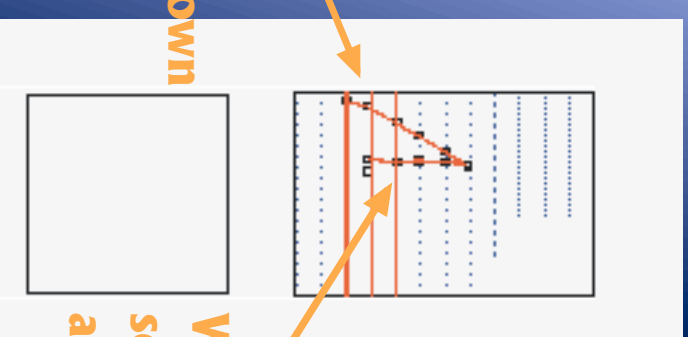High efficiency
at high energy!

FILTER: ESCAPE-TRACK

If (E in CAL < 1 MeV && any tracks escape) then cut

… Cut if no energy info.

Remaining / LLT

Energy (MeV)

Legend: cosmic p, cosmic e, gamma 0 deg, gamma 30 deg, gamma 45 deg
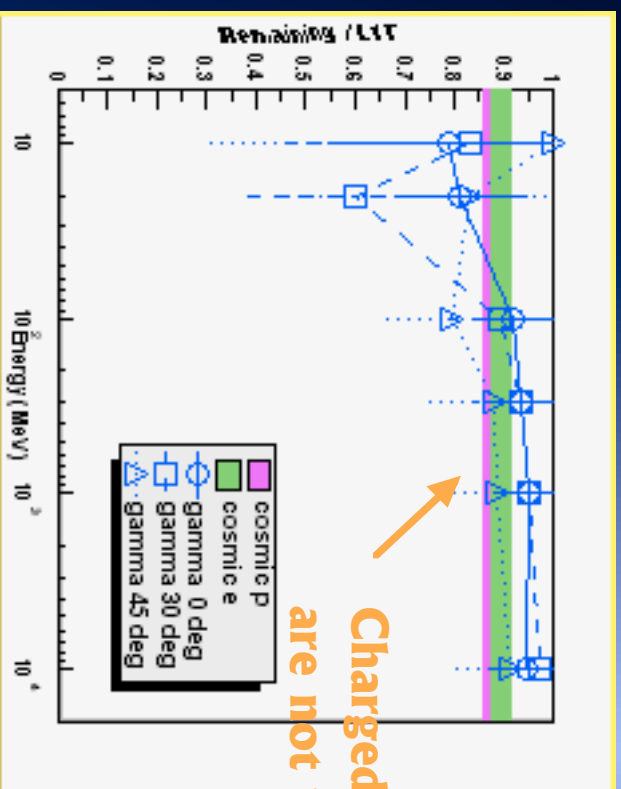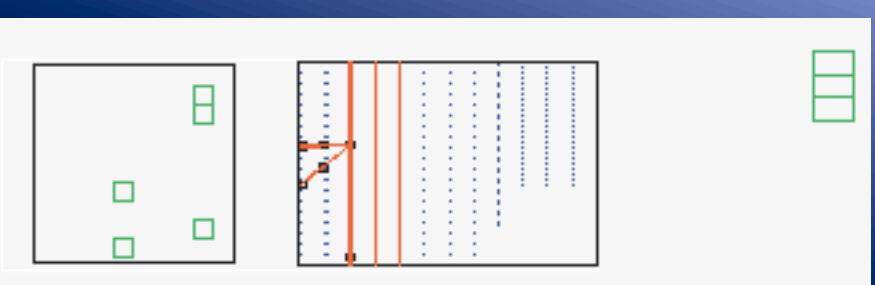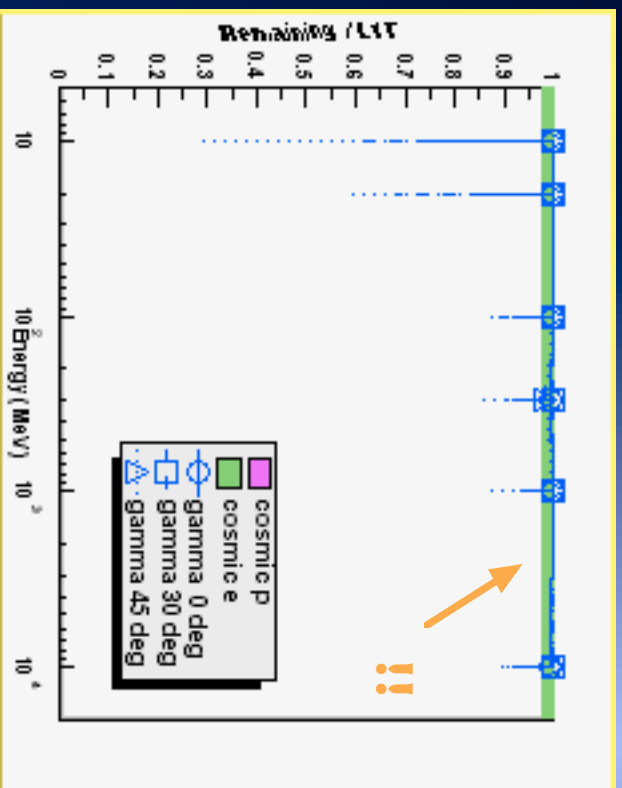
Energy not known

We can say something about this

FILTER: THICK-Pb-LAYER

If (converted in a thick-Pb layer && any tracks escape) then cut

… Cut if direction nor E is not Known

Charged particles
are not well cut
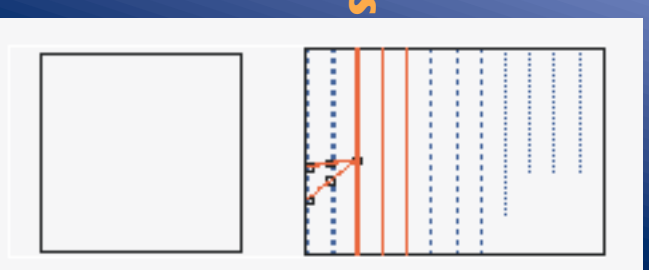
FILTER: WIDE-Λ

If (opening angle of Λ > 60˚) then cut

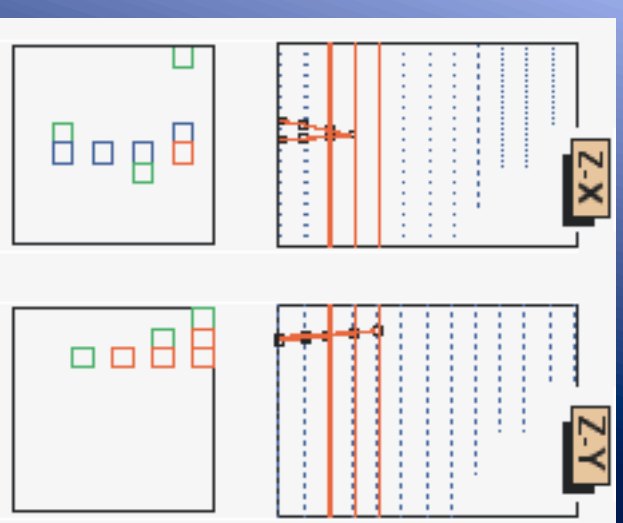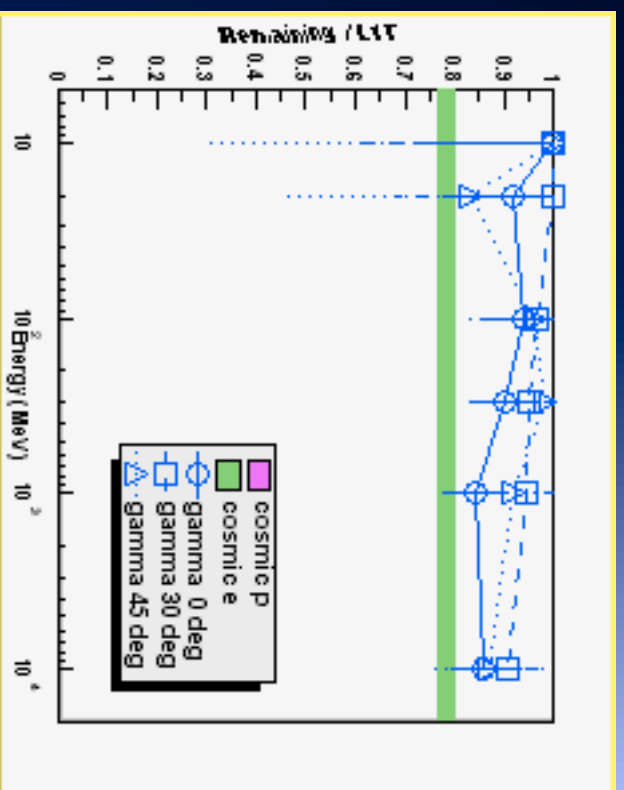**… If Λ is wide, incident direction is uncertain**

Converted in a target?

FILTER: TRACK-ABOVE-VERTEX

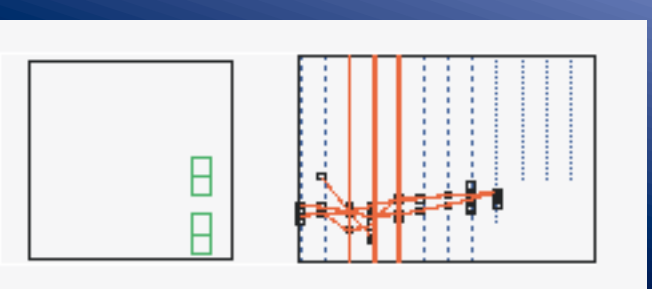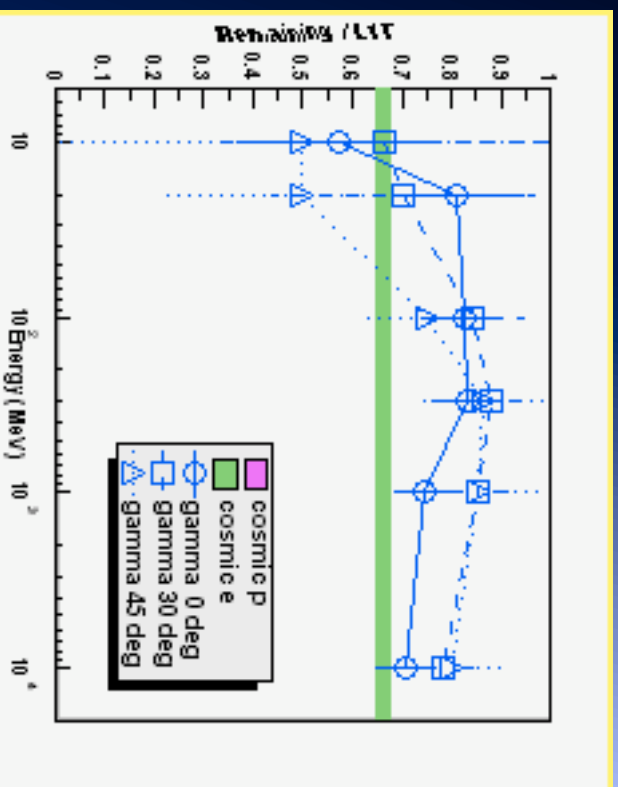**If (any tracks above vertex || num of hits above vertex > 2) then cut**

... A γ ray should not make a hit above its conversion vertex

Missing hit

FILTER: HIT-NEAR-VERTEX

If (any hits near above vertex) then cut

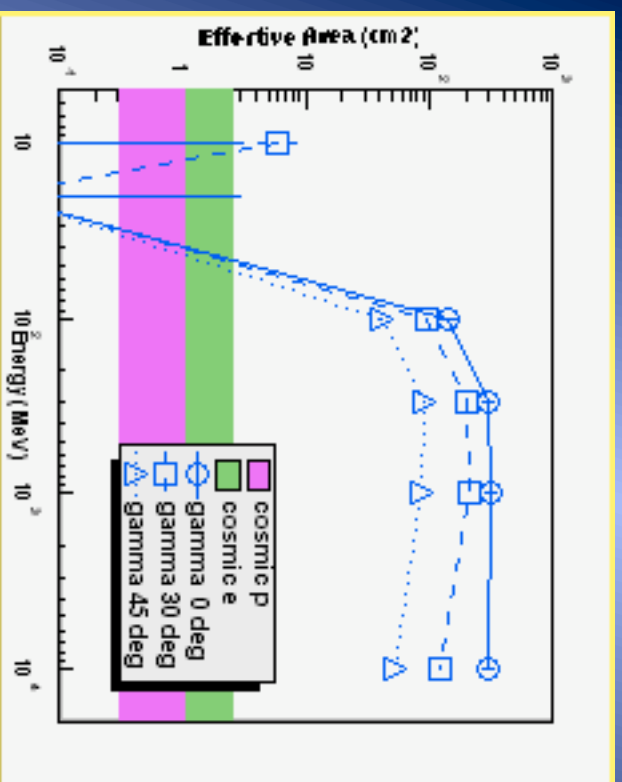**... An event with excess hits around its vertex is doubtful**

Converted in the dead area

EFFECTIVE AREA

Prediction based on simulations:

EA_γ (300 MeV, 0°) = 300 cm2

EAe (ave.) = 1.8 cm2

Remark! This is FILTER-DEPENDENT.

CUMULATION

140 genuine γ rays in the flight data

Level-1 trigger rate = 1
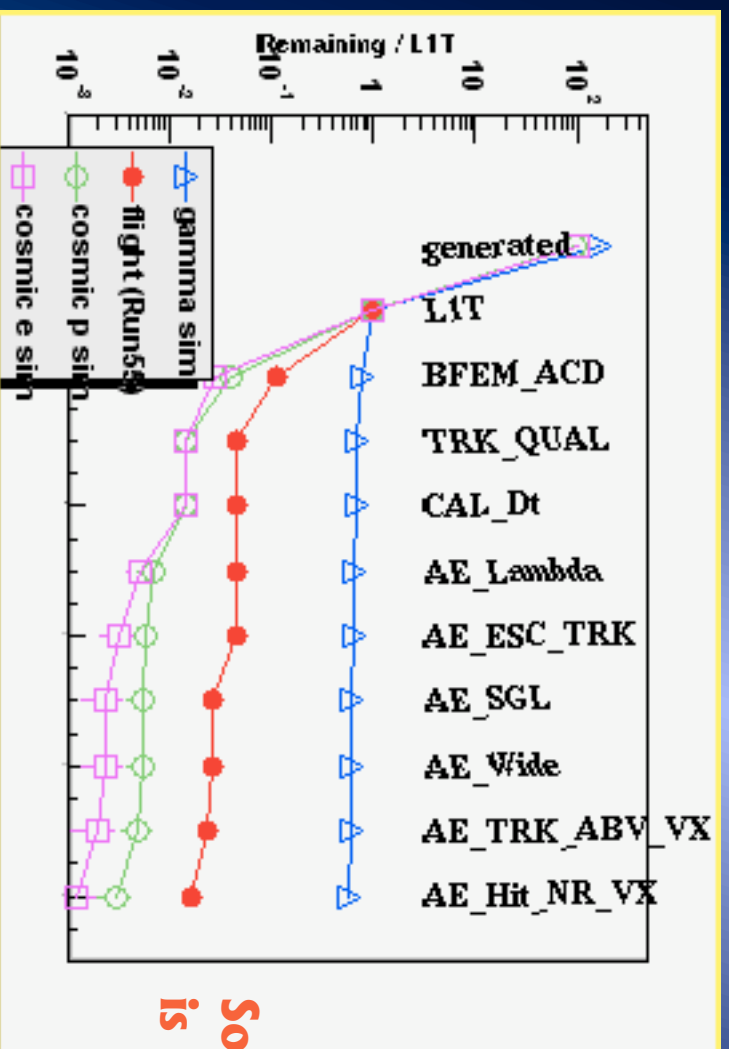
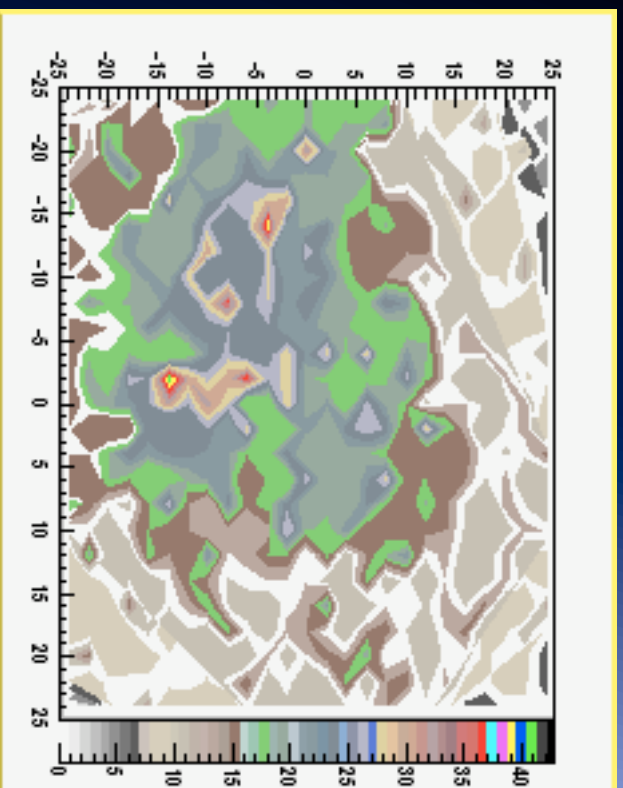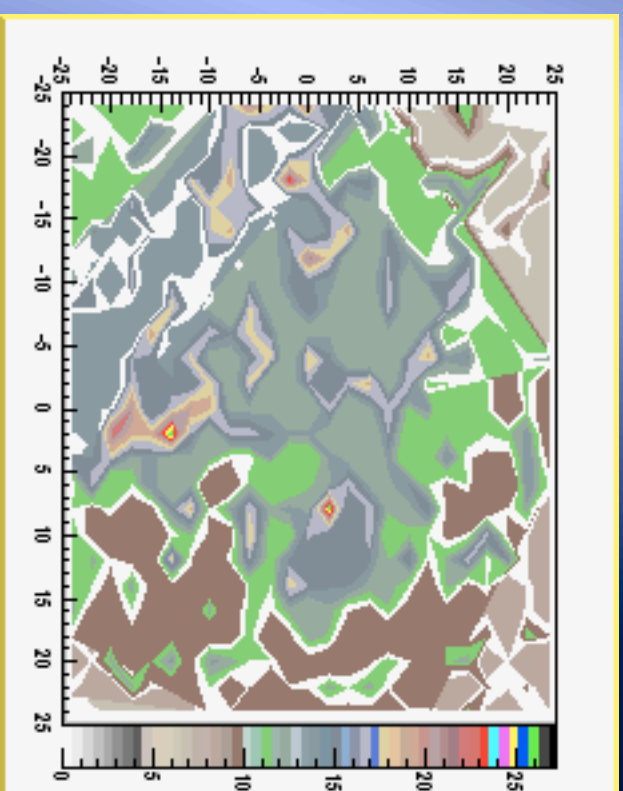Sorry, this graph is still buggy

FILTERED EVENTS: IMAGE

Projection of reconstructed γ-rays

Onto top ACD
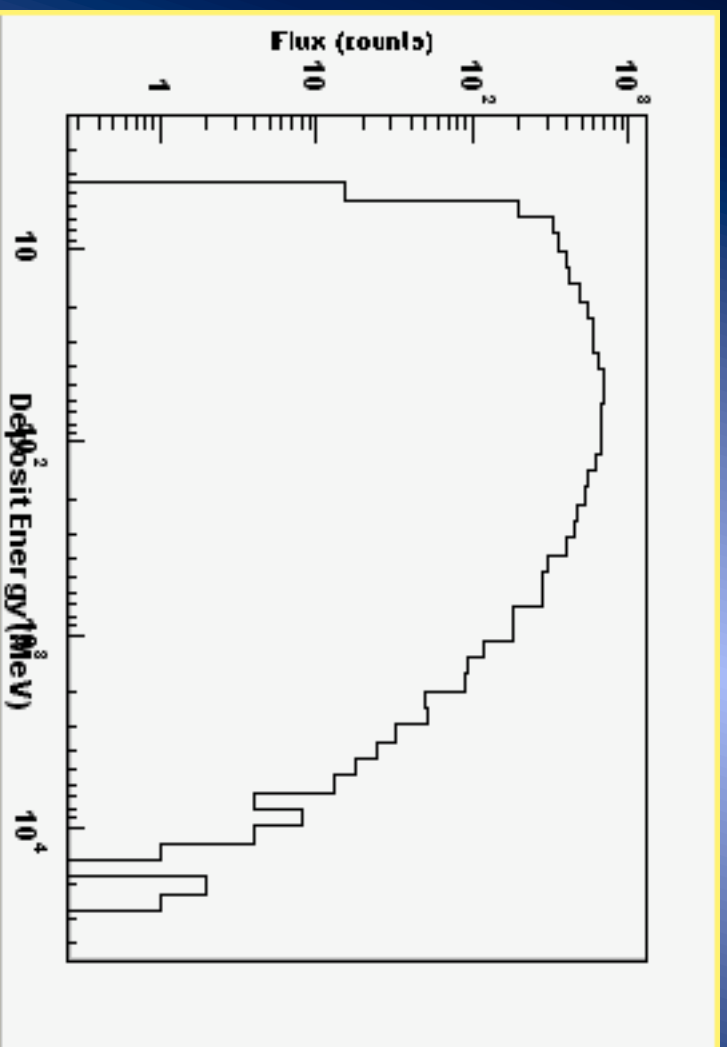**… Cracks btw. tiles visible?**

Onto XGT plane
… No XGT is seen

FILTERED EVENTS: IMAGE

To be compared with theories

Rescued 5.8E5 events

TO DO

Optimize each filter

… Figure of merit = $EA_\gamma (E) / EA_{p,e} (E) > 1$ at any E

… When a filter is added to the filter set, the set's FoM must be improved

CAL-info filter

Distance-of-closest-approach (DOCA) filter